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RUNNING HEAD: Personality, diet and BMI

**The associations between personality, diet and body mass index in older people**

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## **Abstract**

**OBJECTIVE:** Personality traits are related to numerous health outcomes and health-related behaviours. To date, however, little is known about how personality traits are associated with dietary behaviour, an important aspect of lifestyle in the current “toxic food environment”. The present study investigated the associations of between Five-Factor Model personality traits, dietary patterns and body mass index (BMI). **METHODS:** The sample consisted of 1,091 members of Lothian Birth Cohort 1936 tested at age 70 years. Dietary patterns were measured using a detailed and validated food frequency questionnaire (FFQ). Principal components analysis of the FFQ items identified four dietary dimensions, which were named ‘Mediterranean style diet’, ‘health aware diet’, ‘convenience diet’, and ‘sweet foods’. Personality traits were measured with NEO Five-Factor Inventory. The effects of childhood intelligence, education and sex were controlled. **RESULTS:** Endorsing the Mediterranean style diet dimension was associated with high Openness and Extraversion, and low Neuroticism. High scores on the health aware diet dimension were associated with high Agreeableness and Conscientiousness. Endorsing the convenience diet dimension was associated with low Openness and high Neuroticism. Preference for sweet foods was associated with low Openness. High BMI was associated with high scores on the convenience diet dimension and low Conscientiousness. **CONCLUSIONS:** Personality traits, especially Openness, are associated with dietary patterns in older age. The pattern of findings may indicate that, in older people, dietary habits may be less related to how controlled they are and more related to their levels of openness and emotional and social adjustment. Policy implications are discussed.

**Keywords:** personality; diet; BMI; health-behaviours; Openness.

## **Introduction**

An increasing amount of evidence shows that personality differences between people are consequential for various health outcomes, including cardio-vascular disease, heightened blood pressure, diabetes and gastroenterological complaints (Deary, Weiss, & Batty, 2010; Goodwin & Friedman, 2006), increased levels of inflammation (Chapman et al., 2009; Sutin, Terracciano, et al., 2010), and general medical illness burden (Chapman, Lyness, & Duberstein, 2007). Personality traits also relate to the ultimate health outcome—longevity (Kern & Friedman, 2008; Terracciano, Löckenhoff, Zonderman, Ferrucci, & Costa, 2008). Within the framework of the Five-Factor Model (FFM), the currently most widely-used taxonomy of personality traits, the most consistent predictor of the health outcomes is Conscientiousness, which summarizes the tendencies to be orderly, reliable, disciplined and deliberate (Bogg & Roberts, 2004; Chapman et al., 2007). Yet the other FFM personality traits—Neuroticism, Extraversion, Openness, and Agreeableness—are also linked with different aspects of health (Deary, Weiss, & Batty, 2010).

It is often hypothesized that the associations between personality traits and health outcomes are partially mediated by health-related behaviours such as smoking, alcohol use, dietary habits and various other unhealthy behaviours (e.g. Chapman et al., 2007; Goodwin & Friedman, 2006; Sutin, Ferrucci, Zonderman, & Terracciano, in press). Indeed, there is evidence linking personality traits to smoking (Terracciano & Costa, 2004), alcohol consumption (Malouff, Thorsteinsson, Rooke, & Schutte, 2007) and drug use (Terracciano, Löckenhoff, Crum, Bienvenu, & Costa, 2008f), lack of physical exercise (Rhodes & Smith, 2006), and a number of other behaviours that are likely to put people at heightened risk of poor health outcomes (Bogg & Roberts, 2004). Almost every aspect of unhealthy behaviour is related to low Conscientiousness,

but other FFM personality traits also contribute. There are good theoretical reasons, then, to assume that there will also be associations between personality traits and dietary habits, which are known to be implicated in various health outcomes such as metabolic (Azadbakht, Mirmiran, Esmailzadeh, Azizi, & Azizi, 2005), immunological (Lopez-Garcia et al., 2004), cardiovascular (Liu et al., 2009) and cognitive functioning (Gu, Nieves, Stern, Luchsinger, & Scarmeas, 2010).

However, there are in fact only few empirical reports on the relationships between carefully-documented dietary habits and a comprehensive set of personality traits such as those belonging to the FFM. Among the few studies, Goldberg and Strycker (2002) analyzed the factor structure of 48 self-report dietary items in a large sample consisting of people from younger adulthood to old age. They delineated a hierarchical structure with a healthy diet factor at the apex, factors that described avoiding fat and preferring fibre at the second stratum, and several more specific factors at lower levels. Scores on the general healthy diet factor were positively associated with Openness and Conscientiousness domains of the NEO Personality Inventory-Revised (NEO PI-R; Costa & McCrae, 1992). Openness was most consistently associated with the scores on the lower-level factors, whereas high Conscientiousness was associated with avoidance of fats. Low Neuroticism and Extraversion were also occasionally associated with specific dietary factors that described avoidance of various forms of fat (Goldberg & Strycker, 2002). In another study, Brummet and colleagues (2008) found that Openness, but no other FFM personality trait, was associated with higher scores on a comprehensive healthy diet questionnaire in a large sample of married couples in their middle adulthood.

As reviewed above, there is some evidence for the involvement of Openness in healthy diet, but the role of other personality traits including Conscientiousness—the most consistent correlate of other health-related behaviours and health-problems—is unclear. Importantly, however, the

association of Openness to diet may result from the confounding effects of cognitive ability and educational level. Among the FFM personality traits, Openness is the most consistent correlate of cognitive ability (Ackerman & Heggestad, 1997) and Openness also relates to educational level (Allik et al., 2009). At the same time, preference for a healthy diet is predicted by high cognitive ability and educational attainment (Batty, Deary, Schoon, & Gale, 2007). Thus, to estimate the unique associations of the personality trait Openness with diet, one should statistically control for cognitive ability and educational level. To date, this has not been done.

Until the associations between personality traits and dietary habits have been carefully documented, understanding of the pathways linking personality traits with health outcomes will be incomplete. The present study adds to the relatively scarce research on personality-diet associations by testing the relations between comprehensively-measured dietary intake dimensions and FFM personality traits in a relatively large sample of older people. The fact that dietary habits are also consequential in older age is illustrated by their associations with mortality, for instance (Hamer, McNaughton, Bates, & Mishra, 2010). Understanding the links between personality and diet can potentially inform policies and interventions aimed at improving eating habits in the current obesogenic environment (Heber, 2010). For example, knowing that intellectual curiosity—high Openness—does indeed relate to healthier dietary habits (i.e., the observed associations are not confounded by cognitive ability and educational level) could suggest that healthier food items might generally be perceived as unfamiliar and alien. Importantly, such perception could be a target for modification.

As a corollary, the study investigates whether and how personality traits are related to body mass index (BMI) in older age. BMI is a robust correlate of various common health problems such as diabetes and cardiovascular disease (Poirier et al., 2006). High BMI and gains in it over time

have been linked to several FFM personality traits in adults, with the most consistent associations occurring with low Conscientiousness and high Neuroticism (Brummett et al., 2006; Terracciano et al., 2009; Sutin et al., in press). The present study extends previous research by addressing whether the associations of Conscientiousness and Neuroticism (or any other personality trait from the FFM) with BMI could potentially be mediated by dietary habits.

To date, the literature on dietary patterns and BMI is inconsistent (Keith et al., 2006). For instance, the Mediterranean type of diet or empirically-derived diet indices have not been associated with BMI in some studies (Hamer et al., 2010; Rossi et al., 2008; Trichopoulou, Naska, Orfanos, & Trichopoulos, 2005), whereas other studies have found associations between aspects of healthy diet and BMI (McNaughton, Mishra, Stephen, & Wadsworth, 2007; Schröder, Fito, & Covas, 2007). Although the links between diet and BMI are not entirely clear yet, it is possible that any associations between personality traits and BMI are at least partially mediated by diet. If this is correct, personality traits should be significantly correlated with those aspects of diet that are also associated with BMI.

Taken together, in the present study it is hypothesized that healthier patterns of dieting are most strongly related to Openness and Conscientiousness, and it will be examined whether the former association is confounded by cognitive ability and education. Neuroticism and Extraversion may also play some role in healthy diet. High BMI is expected to be most strongly linked with low Conscientiousness, and it will be examined whether the association can potentially be mediated by dietary patterns. It is noted that this is the first study to report personality-diet-BMI associations in older people, a rapidly growing segment of population all over the world, and especially prone to the chronic conditions with which high BMI and poor diet are associated.

## Method

### *Participants*

Participants are members of Lothian Birth Cohort 1936 (LBC1936), a follow-up sample of the participants of the Scottish Mental Survey 1947 (SMS1947; Deary, Whiteman, Starr, Whalley, & Fox, 2004). In the SMS1947, nearly all children born in 1936 who were at school in Scotland were tested with a validated IQ-type test ( $N = 70,805$ ) in June 1947. For an interdisciplinary study on cognitive ageing, surviving participants of the SMS1947 living in Edinburgh, Scotland, and its surrounding areas were recruited into the LBC1936 between 2004 and 2007 (Deary et al., 2007). Initially, 3,686 potential participants of SMS1947 were identified and sent invitations to hear about the planned study. Finally, 1,091 people (548 males), who were aged between 67.7 and 71.3 years ( $M = 69.6$ ,  $SD = 0.80$ ) at time of assessment, were both interested and eligible for participating in the study. About 15% of the sample had university degree, 18% had not completed the first level of formal education (O-level), and the rest fell in between these two extremes. All participants lived independently in the community. Ethics permissions for the study were obtained from the Multi-Centre Research Ethics Committee for Scotland (MREC/01/0/56) and from Lothian Research Ethics Committee (LREC/2003/2/29). Full details on the background of the study, recruitment process, measures and procedures are available elsewhere (Deary et al., 2007).

### *Measures*

*Diet.* Dimensions of dietary intake were assessed using the Scottish Collaborative Group 168-item Food Frequency Questionnaire (FFQ) version 7.0 (Jia, Craig, Aucott, Milne, & McNeill, 2008; Masson, McNeill, et al., 2003). The FFQ has adequate retest reliability and validity for



assessing intake of many nutrients in older populations (Jia et al., 2008). In the FFQ, respondents are presented a list of 168 food or drink items grouped into major food groups (cereal foods, dairy products, meat and poultry, fish, potatoes, rice and pasta, savoury foods, soups and sauces, vegetables, fruits, sweets and desserts, beverages and alcoholic drinks) with a specified quantity (e.g. one slice, one small bowl) and asked how frequently they consumed this quantity of the food. The consumption was rated on a nine-point scale ranging from 'rarely or never' to 'seven or more times per day'. Incomplete questionnaires (with 10 or more missing items) were excluded from the analyses. The amounts consumed for each item on the FFQ were transformed into a common metric (g/d) by multiplying the frequency of consumption by the weight of the specified quantity of the food.

In order to minimise the number of subjective decisions in determining the dietary patterns and retain the full detail of the diet as assessed by the FFQ, it was chosen to quantify the dietary intake dimensions by applying principal components analysis (PCA) followed by varimax orthogonal rotation on all the FFQ items. This is a common approach for quantifying dietary patterns in nutritional research (Craig, McNeill, Macdiarmid, Masson, & Holmes, 2010; Goldberg & Strycker, 2002; Hamer et al., 2010). Inspection of the scree plot for the present data suggested retaining four components, accounting for 11.67% of the total variance. The proportion of explained variance is not large but this is typical in the area (e.g. Hamer et al., 2010). Component scores were calculated with the regression method, using variables with component loadings greater than 0.30.

The first component (22 items) was primarily defined by positive loadings (greater consumption led to higher scores) from vegetables (such as leeks or courgettes, broccoli, salad vegetables), and had also positive loadings from fish, poultry, pasta, rice, water, tomato-based sauces, oil and

vinegar dressing, and beans. Overall, the component captured a healthy diet with particular reference to vegetables and other food items that typically characterise a Mediterranean style diet. Therefore, this component was labelled as ‘Mediterranean style diet’. The second component (14 items) was first of all defined by eating more fruits (such as apples, bananas, tinned fruits, oranges and others) and carrots, and had negative loadings from high consumption of meat products (bacon or gammon, pork or lamb, and sausages), eggs, and spirits or liqueurs. This component also appeared to identify a healthy diet with a strong fruit component and it was labelled as ‘health aware diet’.

The third component (8 items) was defined by eating more tinned vegetables, beans, carrots, cauliflower, swede or turnips, bottled sauces, meat or chicken pies, pasties and sausage rolls, mashed potatoes, custard or other sweet sauces, and milk-based puddings, and drinking less filter, espresso or cappuccino coffee. The content of this component described the degree to which people adhered to a traditional (in Scotland) convenience diet. Accordingly, this component was labelled as ‘convenience diet’. The fourth component (17 items) was defined by eating more sweet foods such as puddings, cakes, biscuits, and chocolate. It was labelled as ‘sweet foods’.

It is noteworthy that the factor solution broadly resembles the findings of another similar study in an older UK population (Hamer et al., 2010).

*Personality.* NEO Five-Factor Inventory (Costa & McCrae, 1992) is one of the most widely used measures to describe individual differences in the five domains of the FFM (Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness). Each of the five broad personality traits is represented by 12 items. Participants were requested to rate how well

they thought each of the 60 items described them on a 5-point Likert-type scale ('very inaccurate' to 'very accurate').

*Cognitive ability.* On June 4, 1947, at age 11, participants of the LBC1936 were administered the Moray House Test no. 12, a group-test of intelligence providing a maximum score of 76. The 45-minute time-limited test included various types of mental tasks such as word classifications, proverbs, arithmetic, spatial items, and others (for a more detailed description see Deary, Whalley, & Starr, 2009). The mean population score in the SMS1947 was 36.74 ( $SD = 16.10$ ). The mean score in 1947 for children who later became participants in LBC1936 was 49.00 ( $SD = 11.80$ ). Raw age 11 scores were adjusted for age at time of testing and converted to a typical IQ-type scale with mean of 100 ( $SD = 15$ ).

*Education.* Highest level of educational attainment was represented with five ordinal categories ranging from 'no qualification' (0) to 'degree' (4).

*BMI.* Participants' height and weight were measured by study personnel during a standardised clinical assessment procedure (Deary et al., 2007). It is noted that only 7 (0.6%) people were below the normal range ( $BMI < 18.5 \text{ kg/m}^2$ ), with the lowest value of  $16.02 \text{ kg/m}^2$  (the highest value was  $48.52 \text{ kg/m}^2$ ). The large majority of the sample (806; 74%) was at least overweight ( $BMI > 25 \text{ kg/m}^2$ ), with a substantial amount (290; 27%) being obese ( $BMI > 30 \text{ kg/m}^2$ ). Because there was substantial and probably meaningful variance within each of the BMI categories of normal, overweight and obesity, BMI was treated as a continuous measure.

## **Results**

The descriptive statistics of study variables are given in Table 1 along with sex differences in them and their correlations with childhood IQ and educational level. Correlations of personality

traits with dietary dimensions and BMI, and also correlations between dietary dimensions and BMI are given in Table 2. In what follows, the effects of sex, education and childhood cognitive ability on the main study variables are described first. This is followed by the presentation of the associations between personality traits, dietary patterns and BMI. In order to illustrate the effect of including the covariates, the bivariate relationships between personality, diet and BMI are contrasted with those adjusted for the effects of sex, childhood cognitive ability, and education. This makes the results of this study readily comparable with those of other studies which may or may not include the covariates.

#### *The effects of sex, education and cognitive ability*

Women scored higher on the presumably healthier dietary dimensions—Mediterranean style and health aware diet—whereas men scored higher on the presumably less healthy convenience diet dimension (Table 1). Women also scored higher in all personality traits except for Conscientiousness. High educational attainment and age 11 IQ contributed to the endorsement of the Mediterranean style diet dimensions and to non-adherence of the convenience diet. More educated people had also slightly higher likelihood of eating more sweet foods. High age 11 IQ and educational level were linked to lower BMI and Neuroticism and notably to higher Openness. This pattern of associations suggests possible confounding effects of sex, cognitive ability and education on the relationships between personality traits, dietary patterns and BMI.

#### *Correlations between personality traits, dietary dimensions and BMI*

Dietary intake dimension scores had a number of significant bivariate associations with personality traits (Table 2). Endorsement of the Mediterranean style diet dimension was significantly associated with lower Neuroticism and higher Extraversion, Agreeableness, and—in

particular—Openness. Endorsing the health aware diet was associated with high Openness, Conscientiousness, and—in particular—Agreeableness. Preference for the convenience diet was significantly associated with high Neuroticism and low Openness, with the latter association being notably stronger. Preference for sweet foods, however, had no significant bivariate associations with any of the personality traits. BMI had significant negative associations with Openness, Agreeableness, and Conscientiousness. Finally, high BMI was significantly related to low scores on the health aware diet dimension and high scores on convenience diet dimension.

Next, the correlations between dietary patterns and personality traits and BMI were residualized for the effects of sex, cognitive ability and educational level (Table 2). This produced notable effects on some of the associations between personality traits, diet and BMI. The correlations of Openness with Mediterranean-style, convenience and health aware diet dimensions were attenuated, with the last association no longer being statistically significant. However, net of the effects of sex, cognitive ability and education, Openness was a significant negative correlate of sweet foods intake. After adjusting for covariates, the positive correlations of Agreeableness with Mediterranean-style and health aware dietary dimensions were also reduced, with the former no longer being statistically significant; closer inspection revealed that this attenuation was almost completely due to adjusting for sex effects. Controlling for the contributions of sex, childhood cognitive ability and education had almost no effect on the associations of Neuroticism, Extraversion and Conscientiousness with dietary patterns. However, the covariates substantially attenuated the correlations of Openness and Agreeableness with body weight, leaving Conscientiousness the only personality trait associated with BMI. Likewise, the associations of adhering to health aware and convenience diet with BMI were attenuated after adjusting for covariates, with the former no longer being statistically significant.

To sum up, Openness was the most consistent correlate of a healthy diet even after controlling for the potential confounders, still having links with Mediterranean-style, convenience and sweet-based diets. The other four personality traits also contributed, although to a somewhat lower extent. As predicted, high BMI was related to low Conscientiousness, but there was little evidence for the association being mediated by dietary patterns, as the only dietary pattern that was independently associated with BMI was not associated with Conscientiousness.

## **Discussion**

The present study showed that, among other factors, older people's personality trait levels are associated with which types of food they choose to consume more relative to others. Four factors reflecting different dietary patterns were identified: Mediterranean-style, health aware, convenience, and sweet dietary patterns. Speaking for the robustness of the dietary patterns, they were broadly similar to those found in another recent study on British elderly (Hamer et al., 2010). Among the FFM personality traits, high Openness was associated with adhering Mediterranean-style diet and avoiding convenience and sweet-based forms of diet. Other personality traits had also links with diet: endorsing the Mediterranean-style diet was related to lower Neuroticism and higher Extraversion, and preference for the health aware diet dimension was associated with higher Agreeableness and Conscientiousness. Preferring a convenience diet was related to higher Neuroticism.

Dietary habits are important because they influence people's health. For instance, adherence to a Mediterranean-style diet (along with increased fruit consumption such as captured in the health aware diet dimension in this study) has been related to decreased risks of all-cause, cardiovascular, and cancer mortality, as well as cognitive impairment and metabolic syndrome

(Bamia et al., 2007; Griep, Verschuren, Kromhout, Ocké, & Geleijnse, in press; Hamer et al., 2010; Rumawas, Meigs, Dwyer, McKeown, & Jacques, in press; Sofi, Cesari, Abbate, Gensini, & Casini, 2008; Tyrovolas & Panagiotakos, 2010). Conversely, sticking to diets rich in meat and highly processed food items (in this study, captured in the low scores on health aware and high scores convenience diet dimensions) has been associated with a variety of adverse health outcomes (e.g. van Dam, Rimm, Willett, Stampfer, & Hu, 2002; Lopez-Garcia et al., 2004). The links between diet and health are likely to be made particularly important by the dramatic increases in the marketing, availability and consumption of highly processed, energy rich convenience foods in recent decades (French, Story, & Jeffery, 2001; Nestle, 2007), creating what is called a “toxic food environment” (Brownell & Horgen, 2004).

As a result of all this, the need for policies and interventions aiming at improving people's dietary habits is widely acknowledged (Apovian, 2010; Wadden, Brownell, & Foster, 2002) and such measures are being taken all over the developed world. The success of the intervention, however, is likely to depend on how well they are tailored to the determinants of people's dietary habits. Therefore, knowing what drives people's dietary habits is of great practical and clinical importance. Based on this, the findings of the present study can potentially inform the policies interventions targeted to changing dietary habits, especially among older people.

Perhaps the most interesting finding of the study is that it is not only, or even mainly, the levels of discipline, orderliness and other aspects of Conscientiousness that influence adherence to forms of diet that are commonly promoted as being healthy (i.e., the Mediterranean and health aware diet dimensions) and avoidance of food items that are commonly seen as less healthy (convenience and sweet-based diet). Although Conscientiousness has been associated with cognitive dietary restraint—tendency to control of food intake, primarily due to concerns about

body shape and weight—in women in middle adulthood (Provencher et al., 2008), its role in preferring one type of food over others was not particularly strong in the present large study of older people. This finding may be specific to old age when concerns about appearance and attractiveness are possibly less relevant compared to younger ages. Thus, although Conscientiousness has shown to be the most important personality correlate of various other health-related aspects of life-style, in diet other personality traits appear to take a more prominent role. In particular, Openness was the strongest correlate of healthier eating habits, even after accounting for the confounding effects of cognitive ability and education. This is consistent with a few previous studies on the topic (Brummett, Siegler, Day, & Costa, 2008; Goldberg & Strycker, 2002), suggesting that association of Openness to diet is indeed robust and reliable.

Assuming that high Openness is causal to a healthy diet, its associations with the consumption of vegetable, rice, pasta, fish and poultry, and the avoidance of pasties, sausage rolls and other convenience and sweet foods could be explained by intellectually open and curious people more readily adopting novel dietary habits that are adaptive in changed environmental conditions. Amidst the vastly increased availability of food, including energy-rich food items, in recent decades, it is possible that sticking to the traditional Scottish diet (which is not particularly fresh vegetable-based but relies more on processed food) is no longer as healthy and adaptive as it used to be when processed foods were available in lower quantities. Instead, preference for a more Mediterranean-like diet may be more beneficial in the changed conditions, as evidenced by its relations to reduced mortality risk in older age (Hamer et al., 2010). Associations with Openness may suggest, however, that the now-healthier forms of diet are generally considered somewhat foreign and unusual by older Scottish people: it perhaps depends partly upon some



extra openness and intellectual curiosity to increase the likelihood that modern and healthier dietary habits will be adopted.

Therefore, policies, interventions and consulting aimed at improving dietary habits in older people could include seeking ways of making healthy food items more familiar and less of an exotic-seeming experience for people. That is, for policy purposes, the present findings are useful in informing about the types of individuals who are likely not to be adopting healthier diets, but also in suggesting ways to lower personality-trait barriers to better eating habits in general (e.g., if Mediterranean-type foods are familiarized to all, consuming them will no longer be more characteristic of people higher in Openness).

On one hand, the finding that without higher Openness people are less likely to adopt modern and healthier dietary habits might be especially characteristic of older people who developed their eating habits before the relatively recent increases in the prevalence of being overweight (Howel, 2011) and accompanied public awareness of healthy diet. On the other hand, the few other studies reporting roughly similar results were carried out on adults at less advanced ages (Brummett et al., 2008; Goldberg & Strycker, 2002), suggesting that the role of Openness in dietary habits may not be limited to old age.

High Extraversion and Agreeableness, which imply more and closer social contacts, may also be helpful in learning about and adopting new dietary habits, whereas high Neuroticism may work against it. In particular, low emotional adjustment may incline people more towards traditional habits, including preference of a traditional convenience diet. Taking the findings together, then, the relative food preference may be less related to how controlled people are and more related to their openness and levels of emotional and social adjustment. In other words, lack of curiosity, as

well as low emotional and social adjustment may be more important reasons for sticking to unhealthy diet than low discipline and orderliness.

So far, the interpretations have assumed that personality traits are causal to dietary patterns. However, there may be alternative causal explanations. It is possible, in principle, that failing to eat enough healthy food is detrimental to people's health and this, in turn, makes them less open and emotionally less stable, for instance. Further, it is possible that there are factors not addressed in this study that influenced both diet and personality traits. For example, both dietary preferences and personality traits may be influenced by similar genetic variants, which would be a case of apparent association caused by confounding.

Higher BMI was independently related to low Conscientiousness but no other personality traits. This is consistent with previous studies reporting Conscientiousness to be a consistent predictor of BMI (e.g. Brummett et al., 2006; Terracciano et al., 2009; Sutin et al., in press); however, in these other studies high Neuroticism has also been often associated with high BMI, which was not observed in the present older sample. With regard to diet, when education, cognitive ability and sex were controlled for, higher BMI was related to eating more convenience food but no other aspects of diet. Importantly, convenience food dimension was not related to Conscientiousness. This suggests that, although Conscientiousness is associated with BMI, this is probably not due to adhering to particular forms of diet. Therefore, there probably have to be other mechanisms linking personality traits such as Conscientiousness to BMI, at least in older people. For example, the associations between Conscientiousness and BMI may be mediated by physical activity (Rhodes & Smith, 2006) or various other pathways such as sleeping habits or temperature preference (Keith et al., 2006).

The relatively modest association between self-reported dietary habits and BMI is a frequently observed phenomenon (cf. Keith et al., 2006). One of the reasons for this may be related to differential reporting of food consumption: it has been found that people with higher BMI may underreport their energy intake (Bazelmans et al., 2007). However, the FFQ used in this study has been shown predict the nutrition intake (based on four-day diet record) for most but not all nutrients in older people (Jia et al., 2008). In the current study, it was not possible to test this and, therefore, it is assumed that reporting of *relative* food consumption (i.e., which items were more consumed compared to others) was unbiased.

The major strengths of the study include a relatively large sample size and carefully and comprehensively measured dietary habits. Another important strength was the availability of information on participants' educational attainment and early cognitive ability, which are known to be associated with numerous health-related behaviours and health outcomes across the life-course (Deary et al., 2009) and could have confounded (and to a notable extent did confound) personality-diet or personality-BMI associations. Additionally, participants' narrow age range excluded the confounding effects of chronological age and cross-generational differences. Likewise, the fact that participants originated from and lived in the same region helped to control for the effects of sociocultural factors. The major limitation of the study is related to personality and diet being measured concurrently and only once. It is likely that dietary habits and their correlates change across life-course and sociocultural circumstances. Therefore, the conclusions of the present study may be limited to the particular cohort and age-group. The available information also made it difficult to make causal inferences regarding the associations between personality, diet and BMI. Another limitation was the use of self-reported dietary information.

However, this is commonly regarded as the only way of obtaining information about dietary habits.

To conclude, the pattern of findings reported in this study may mean that, in older people, relative food preference is less related to how controlled people are and more related to how open and emotionally and socially adjusted they are. Although personality traits themselves are not likely to be modifiable in order to influence people's dietary behaviour, this information suggests potential barriers to a healthy diet (lack of intellectual curiosity—and perhaps information—and social embeddedness), which may be more easily modifiable. Indeed, of special interest is the finding that more open and intellectually curious people are the most likely to pick up healthy dietary habits—this may indicate that healthy food items are generally somewhat alien and unfamiliar to older people. These findings may inform policies, interventions and counselling related to improving dietary habits of older people—a growing target group for such efforts.

## **Authors' note**

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Table 1. Descriptive Statistics and Interrelations between Study Variables.

	Total sample			Men		Women		<i>d</i> (sex)	<i>r</i> <sub>IQ</sub>	<i>r</i> <sub>education</sub>
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Neuroticism	954	17.09	7.61	15.75	7.60	18.39	7.39	-0.35***	-.13 ***	-.13 ***
Extraversion	943	26.97	5.93	26.56	6.07	27.37	5.77	-0.14*	-.01	-.06
Openness	947	26.05	5.81	25.16	5.67	26.91	5.82	-0.30***	.28 ***	.33 ***
Agreeableness	954	33.46	5.26	31.84	5.23	35.03	4.79	-0.64***	.09 **	.04
Conscientiousness	947	34.66	5.97	34.44	6.02	34.88	5.92	-0.07	-.04	-.02
Mediterranean-style diet	882	0.00	1.00	-0.13	0.85	0.12	1.11	-0.25***	.17 ***	.26 ***
Health aware diet	882	0.00	1.00	-0.35	0.99	0.32	0.90	-0.71***	-.03	.00
Convenience diet	882	0.00	1.00	0.15	1.00	-0.14	0.98	0.30***	-.23 ***	-.26 ***
Sweet foods	882	0.00	1.00	0.00	1.11	0.00	0.88	0.01	.06	.10 **
BMI ( kg/m <sup>2</sup> )	1089	27.79	4.36	28.03	3.88	27.54	4.78	0.11	-.15***	-.18 ***
Age 11 IQ	1028	100.00	14.99	99.00	15.89	101.03	13.96	-0.14*	—	—
Educational level	1089	1.66	1.30	1.75	1.35	1.57	1.24	0.14*	—	—

NOTE: *N* = number of observation, *M* = Mean, *SD* = Standard Deviations; *d* = Cohen's *d* showing the effect size of gender differences (positive values indicate higher scores for men); *r*<sub>IQ</sub> = correlation with IQ; *r*<sub>education</sub> = correlation with educational level; BMI = body mass index ( kg/m<sup>2</sup>).

\* = *p* < .05, \*\* = *p* < .01, \*\*\* = *p* < .001.

Table 2. Bivariate and multivariate correlations between personality traits, dietary dimensions and BMI.

	Mediterranean-style diet		Health aware diet		Convenience diet		Sweet foods		BMI	
	<i>r</i>	<i>r<sub>p</sub></i>	<i>r</i>	<i>r<sub>p</sub></i>	<i>r</i>	<i>r<sub>p</sub></i>	<i>r</i>	<i>r<sub>p</sub></i>	<i>r</i>	<i>r<sub>p</sub></i>
Neuroticism	-.07*	-.07*	.06	.00	.08*	.08*	-.01	.00	.03	.01
Extraversion	.09**	.10**	.06	.03	-.01	-.01	-.04	-.04	-.02	-.03
Openness	.33***	.21***	.10**	.05	-.21***	-.09**	-.05	-.08*	-.10**	-.02
Agreeableness	.08*	.03	.21***	.11***	-.03	.03	.03	.03	-.08*	-.06
Conscientiousness	.01	.03	.08*	.07*	.00	-.01	.01	.02	-.07*	-.08*
BMI	-.03	.03	-.08*	-.06	.14***	.08*	-.06	-.06	—	—

NOTE: *r* = zero-order correlation; *r<sub>p</sub>* = partial correlation adjusted for the effects of sex, childhood IQ scores and educational level; BMI = body mass index. \* =  $p < .05$ , \*\* =  $p < .01$ , \*\*\* =  $p < .001$ .